Transformation of Epitaxial Gallium Telluride Hexagonal Phase into Two-Dimensional Single Crystal Monoclinic

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Research on van der Waals (vdW) materials is calling for deeper understanding of their epitaxial growth as well as for the development of scalable and high-crystalline-quality materials. Novel device technologies based on two-dimensional (2D) materials request the realization of stable and near perfect structure on crystalline substrates and the ability to grow on large-area. 2D gallium and indium monochalcogenides with low in-plane symmetry are attracting increasing attention among the 2D semiconductor materials family for next generation optoelectronic and energy conversion applications [1]. Single crystal, large-area, and optically active 2D monoclinic gallium telluride (m-GaTe) on silicon substrate were produced via rapid thermal annealing induced phase transformation of vdW-type MBE grown metastable hexagonal phase (h-GaTe) [2]. The fundamental role of the first layer symmetry to favour the growth of the multilayer h-GaTe on Si was shown by first principles calculations [3]. Furthermore, we show that the h-GaTe to m-GaTe phase transformation is accompanied by the strain relaxation between Si substrate and GaTe. In more general terms, this work establishes a fabrication method for single crystal 2D anisotropic semiconductors integrated on silicon and explores ways to control unstable phases of matter, both highly relevant for the realization of 2D layered films based multifunctional devices.

References

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